REMARKS

Claims 69, 77, 78, 81 and 88 have been amended. New claims 96-99 have been introduced. Claims 1-45, 49, 53 and 59-68 were previously canceled. Now pending in the application are claims 46-48, 50-52, 54-58, and 69-95, of which claims 46, 50, 52, 57, 69, 77, 78, 81, 88, 92, 93, 96, 97 and 99 are independent. No new matter has been introduced. The Applicants appreciate the Examiner's thorough examination of the application and request reexamination and reconsideration of the application in view of the preceding amendments and the following remarks.

The claimed invention of the present application is generally directed to a system with an atlas and a method for creating an atlas comprising values representative of magnetic resonance properties of a magnetic resonance scan (MR) and probability data relating to tissue type from one or more subjects.

For the sake of effective and productive communication, Applicants respectfully request that the Examiner cite a specific passage in a reference corresponding to each element of the Applicants' invention that the Examiner states is disclosed by the reference. In the current Office Action it is unclear which paragraph is meant to disclose each element as some cited paragraphs seemed totally unrelated to the claimed invention.

Claim Rejections – 35 USC § 101

Claims 69-91 were rejected under 35 U.S.C. §101 as being directed to non-statutory subject matter. The Applicants respectfully traverse the rejection with the above amendments and the following arguments.

Claims 69, 77, 78, 81, and 88 have been amended to recite "An atlas embodied on a computer-readable medium..." A computer-readable medium encoded with a data structure

defines structural and functional interrelationships between the data structure and the computer software and hardware components which permit the data structure's functionality to be realized, thus, claims 69-91 are statutory. Reconsideration and withdrawal of the rejection is requested.

Claim Rejections – 35 USC § 102

The claimed invention of the present application is generally directed to a system with an atlas and a method for creating an atlas with nodes including values representative of magnetic resonance properties of a magnetic resonance scan (MR) and probability data relating to tissue type.

Rejections in view of deCharms

Claims 46-48, 50-52, 54-58 and 69-95 were rejected under 35 U.S.C. 102 (e) as being anticipated by U.S. Patent Application 200220103428 to deCharms (hereafter deCharms). Applicants respectfully traverse the rejection with the following arguments.

The deCharms reference is generally directed to computer executable software and a device for guiding brain activity training. The invention takes data corresponding to brain activity measurements in internal voxels of a brain, and determines information relevant to brain activity training.

Claims 46-48

Applicants respectfully submit that deCharms does not disclose "an atlas having magnetic resonance data including tissue type prior probability derived from at least one other subject" as recited in claim 46. deCharms discloses relating scan images to the physical structure of the brain, but deCharms does not disclose the atlas specified in claim 46.

The Examiner cites paragraphs [0160], [0164], [0167], [0178] and [0326-0330] to support that deCharms discloses "obtaining information regarding a subject by using... an atlas comprising values representative of the magnetic property of a spatial location of a subject." Applicants agree that deCharms relates data to anatomical brain regions, as this is clearly known in the prior art, however, the invention of claim 46 includes a specific atlas having magnetic resonance data including tissue type prior probability from at least one other subject, which is not disclosed in deCharms.

A brief description of the contents of each cited paragraph will be presented. The first four paragraphs cited are functional definitions of terms: paragraph [0160] is the definition of a region of interest, paragraphs [0164] and [0178] are definitions of a scan volume and a voxel, and paragraph [0167] is the definition of a spatial activity pattern for the brain.

Paragraph [0326] discloses that once anatomical data has been collected for a subject, anatomically defined brain regions may be localized for the subject with reference to the collected anatomical information using either reference to a standard anatomical atlas or using a manual search. Paragraph [0327] discloses how to perform a manual search. Paragraph [0328] discloses that, preferably, software used in combination with the brain scanning device converts the anatomical data to a form that may be displayed or communicated. Paragraph [0329] discloses software that makes a 3-D transformation from standard space to the space of the subject's brain and back in substantially real time. Paragraph [0330] discloses another example of defining a region of interest anatomically by using a defined anatomical region from a reference brain such as Talairach or Montreal Neurological Institute coordinates.

In summary, there is no discussion of an atlas comprising values representative of the magnetic property of a spatial location of a subject in these cited paragraphs of deCharms.

The Office Action specifically cites paragraphs [0614 -0615] to establish that "deCharms teaches tissue type probability corresponding to a tissue type." Even to the extent that deCharms may disclose tissue type probability, this does not begin to suggest the Applicants' claimed utilization of tissue type prior probability information in an atlas with nodes and magnetic resonance property information. This is due in part to the fact that deCharm does not disclose, among other things, magnetic properties by nodal location. Additionally the Office Action cites paragraphs [0180], [0256], [0270], [0326], [0328], [0329], [0439], [0465], [0471], [0525] and [0625] and states that deCharms labels "tissue types corresponding [to] the magnetic resonance property values pertaining to the subject by the use of the atlas having said MR values derived from other subjects." A prior probability associated with a given data value may be thought of as the probability that the unit, in this case a voxel, belongs to a given class, in this case a tissue type, given a particular data value for that unit, in this case a magnetic resonance data value for the voxel. A summary of each paragraph will be presented to establish that these paragraphs do not disclose an atlas with tissue type prior probability values.

Paragraph [0180] gives a summary of the invention, which does not mention an atlas or tissue types. Paragraph [0256] discusses using an MRI to take data. Paragraph [0270] discusses acquiring whole brain MRI data and registering physiological data (brain activity data) with anatomical data. Paragraphs [0326] through [0329] discuss using an atlas or a manual search to identify brain anatomical structures, but these paragraphs do not disclose an atlas with prior probability tissue type values. Paragraph [0439] discloses image smoothing. Paragraph [0465] discusses a variance volume. Paragraph [0471] discusses a threshold volume. Paragraph [0485] discusses movement metrics. Paragraph [0525] discusses identifying regions of interest from an anatomical section. Paragraph [0625] discusses testing the ability of subjects to modulate their brain activity without feedback.

Paragraph [0264] discloses collecting detailed anatomical scans using MRI, that T1 and/or T2 weighted anatomical data are collected from axial slices through the head which will be in substantial register with physiological data collected later, and that higher resolution data may be collected as well to allow more detailed anatomical localization by changing the number of voxels in each of the three dimensions.

None of the cited paragraphs summarized above disclose "an atlas having magnetic resonance data including tissue type prior probability derived from at least one other subject," as recited in independent claim 46.

Additionally, deCharms does not disclose "determining alignment of said magnetic resonance scan to obtain a specific geometry of a subsequent magnetic resonance scan," as recited in claim 46. The Office Action cites paragraphs [0160], [0164], [0167], [0178] and [0326-0330] to establish "determining alignment of the MR scan based on the atlas". All of these paragraphs have been summarized above. As is shown in those summaries, none of the cited paragraphs disclose determining alignments of the MR scan based on the atlas to obtain a specific geometry of a subsequent magnetic resonance scan.

deCharms does not disclose each and every element of claim 46, thus, the claim is patentable. Claims 47 and 48 depend from independent claim 46 and are therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 46-48 is requested.

Claims 50 and 51

Applicants respectfully submit that deCharms does not disclose "an atlas having at least two magnetic property values for at least one corresponding voxel derived from at least one other subject; and labeling by said processor of tissue types corresponding to said magnetic

resonance property values... by the use of said atlas," as recited in independent claim 50. The Office Action cites paragraphs [0180], [0256], [0264], [0270], [0326], [0328], [0329], [0439], [0465], [0471], [0485], [0525] and [0625] in support of the argument that "deCharms teaches...providing magnetic property values corresponding to tissue types and subject, labeling tissue types corresponding [to] the magnetic resonance property values pertaining to the subject by the use of the atlas having said MR values derived from other subjects..." As can be seen in the summaries of these cited paragraphs above, none of these paragraphs disclose an atlas "having at least two magnetic property values for at least one corresponding voxel derived from at least one other subject; and labeling by said processor of tissue types corresponding to said magnetic resonance property values... by the use of said atlas," as recited in independent claim 50.

deCharms does not disclose each and every element of independent claim 50, which is therefore patentable. Claim 51 depends from independent claim 50 and is therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 50 and 51 is requested.

Claims 52, 54, 55 and 56

Applicants respectfully submit that deCharms does not disclose each and every element of claim 52. Specifically, applicants submit that deCharms does not disclose, "correcting distortion of said first magnetic resonance modality volume; and recording a magnetic property value in a node of said atlas corresponding to a voxel of said first magnetic resonance modality volume," as recited in independent claim 52. The Office Action cites paragraphs [0260] and [0449] as evidence that deCharms discloses the subject matter of claim 52. Paragraph [0260] discloses a method of using a physical device to stabilize motion, and "if necessary" motion

stabilization software to correct motion. In this context, the citation reference (CC Lee, et.al.) motion correction performed on the MRI scanner prior to obtaining acquired volumes for post-processing applications, and is irrelevant to the discussion of correction of artifacts of one or more magnetic property features for inclusion or use with an Atlas as described in this invention. Paragraph [0449] discusses software that transforms scan volumes and motion correction software. Transforming scan volumes and motion correction software is known, however, correcting distortion of a magnetic resonance modality volume, then recording a magnetic property value in a node of the atlas corresponding to a voxel of the corrected magnetic resonance modality volume is new and is not disclosed by deCharms. deCharms does not disclose each and every element of independent claim 52, which is therefore patentable. Claims 54, 55, and 56 depend from independent claim 52 and are therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 52, 54, 55 and 56 is requested.

Claims 57 and 58

Applicants respectfully submit that deCharms does not disclose each and every element of independent claim 57. Specifically deCharms does not disclose, "correcting distortion of said first magnetic resonance modality volume...and recording magnetic property data corresponding to each tissue type in a node of said atlas corresponding to a voxel of said first magnetic resonance modality volume," as recited in independent claim 57. As was discussed in the previous paragraph, deCharms does not disclose an atlas with a corrected magnetic resonance modality volume. Further, cited paragraphs [0260] and [0449] do not disclose an atlas with both a corrected magnetic modality volume and labeled tissue types. deCharms does not disclose each and every element of independent claim 57, which is therefore patentable. Claim 58

depends from independent claim 57 and is therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 57 and 58 is requested.

Claims 69-76

Applicants respectfully submit that deCharms does not disclose each and every element of amended independent claim 69. Specifically, deCharms does not disclose an atlas with "a plurality of nodes corresponding to a plurality of voxels representing spatial locations of a subject, each of said nodes configured to store at least two magnetic property values of each of said voxels," as recited in claim 69. The Office Action cites paragraphs [0188-0189], [0193], [0221], [0264], [0459-0460], [0525] and [0619-0620] to establish that deCharms discloses the invention of claim 69. Applicants will summarize these paragraphs to establish that deCharms does not disclose all of the elements of claim 69.

Paragraphs [0188]-[0189] disclose that, in one variation, regions of interest targeted by deCharms are internal relative to a surface of the brain, and that deCharms is able to treat those internal localized regions of the brain by using brain scanning technology, namely MRI for measurement. deCharms states that MRI technology overcomes the obstacle of measuring internal brain activity without substantial contamination from surrounding and intervening tissue. The physical qualities of an MRI scan are not relevant to Applicants' claimed magnetic property values within a node of an atlas.

Paragraph [0193] discloses that the invention claimed in deCharms can be applied to subject-specific conditions involving a decrease in activity within a discretely localized region, and paragraph [0221] discloses exercises to treat brain lesions. Again, this not relevant to the Applicants' claimed magnetic property values within a node of an atlas.

Paragraph [0264] discloses collecting detailed anatomical scans using MRI, that T1 and/or T2 weighted anatomical data are collected from axial slices through the head which will be in substantial register with physiological data collected later, and that higher resolution data may be collected as well to allow more detailed anatomical localization by changing the number of voxels in each of the three dimensions. Utilizing T1 and T2 is known, but nodes in an atlas including at least two magnetic property values, is not disclosed by deCharms.

deCharms paragraph [0459] discloses computing difference images. deCharms states that a "single T2* weighted image by itself gives little information about the activity level at each voxel position," but discloses using the difference in T2* signal intensity between two time points as an indicator of the difference in physiological activation between those two time points. In contrast to claim 69, however, one intensity value at two time points disclosed by deCharms is not the same as the Applicants' claimed at least two magnetic property values at a single node location. Paragraph [0460] of deCharms simply discloses the concept of subtracting a reference scan from subsequent scans.

Paragraph [0525] discloses a display panel which may represent a T1, T2, or T2* weighted anatomical section of the subject, and this panel may be used to compare with another subject or a standard reference brain. However, as discussed above, although utilizing T1 and T2 or T2* is known, nodes including at least two magnetic property values and location information, is not disclosed by deCharms.

Paragraphs [0619]-[0620] of deCharms disclose T1-weighted saggital localization scans conducted to localize the brain precisely and achieve registration, and T1-weighted anatomical scans are also conducted to precisely image the brain and central nervous system. Again, there is no disclosure concerning nodes including at least two magnetic property values and location information as claimed by the applicants.

To conclude the previous paragraphs, deCharms does not disclose an atlas with "a plurality of nodes corresponding to a plurality of voxels representing spatial locations of a subject, each of said nodes configured to store at least two magnetic property values of each of said voxels," in the cited paragraphs or in any other paragraphs. Thus, amended claim 69 is patentable. Claims 70-76 depend from amended claim 69, and are therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 69-76 is requested.

Claim 77

Applicants respectfully submit that deCharms does not disclose each and every element of amended independent claim 77. Specifically, deCharms does not disclose an atlas with "a plurality of nodes corresponding to a plurality of voxels representing spatial locations of a subject,... configured to store at least one magnetic property value and at least one tissue type prior probability value corresponding to a tissue type of a voxel," as recited in amended independent claim 77. As was discussed above, deCharms does not disclose an atlas with tissue type prior probability values. deCharms does not disclose each and every element of amended independent claim 77, which is therefore patentable. Reconsideration and withdrawal of the rejection of claim 77 is respectfully requested.

Claims 78-80

Applicants respectfully submit that deCharms does not disclose each and every element of amended independent claim 78. Specifically, deCharms does not disclose an atlas with "a plurality of nodes configured to store values of a statistical representation of at least one magnetic property value...and a statistical representation of at least one tissue type probability

value...for each of a plurality of corresponding voxels of a plurality of subjects," as recited by amended independent claim 78. As was discussed above, deCharms does not disclose an atlas with tissue type prior probability values. deCharms does not disclose each and every element of amended independent claim 78, which is therefore patentable. Claims 79 and 80 depend from amended independent claim 78 and are therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 78-80 is requested.

Claims 81-87

Applicants respectfully submit that deCharms does not disclose each and every element of amended independent claim 81. Specifically, deCharms does not disclose an atlas with "a plurality of nodes each configured to store values of a statistical representation of at least two magnetic property values ... for each of a plurality of corresponding voxels of a plurality of subjects," as recited in amended independent claim 81. As has been discussed previously, deCharms does not disclose the details of an atlas with nodes configured to store a statistical representation of at least two magnetic property values for corresponding voxels of a plurality of subjects. deCharms does not disclose each and every element of claim 81, which is therefore patentable. Claims 82-87 depend from amended independent claim 81 and are therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 81-87 is requested.

Claims 88-91

Applicants respectfully submit that deCharms does not disclose each and every element of amended independent claim 88. Specifically, deCharms does not disclose an atlas with "a plurality of nodes corresponding to a plurality of voxels...configured to store a prior probability of a tissue type...and a statistical value of a magnetic property," as recited in amended independent claim 88. As has been discussed previously, deCharms does not disclose an atlas with nodes configured to store prior probability type tissue data and a statistical value of a magnetic property. deCharms does not disclose each and every element of amended independent claim 88, which is therefore patentable. Claims 89-91 depend from amended independent claim 88 and are therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 89-91 is requested.

Claim 92

Applicants respectfully submit that deCharms does not disclose each and every element of independent claim 92. Specifically, deCharms does not disclose "each of said nodes configured to store at least two magnetic property values for each of said voxels or at least one magnetic property value and one tissue type probability value," as recited in independent claim 92. As was discussed above, deCharms does not disclose an atlas with at least two magnetic property values for each voxel or an atlas with a tissue type prior probability value, thus deCharms does not disclose each and every element of independent claim 92. Claim 92 is therefore patentable. Reconsideration and withdrawal of the rejection of claim 92 is respectfully requested.

Claims 93-95

Applicants respectfully submit that deCharms does not disclose each and every element of independent claim 93. Specifically, deCharms does not disclose "an atlas having magnetic resonance data including more than one magnetic property prior probability value derived from at least one other subject...determining alignment of said magnetic resonance scan to obtain a specific geometry of a subsequent magnetic resonance scan," as recited in independent claim 93. In the paragraphs cited in the Office Action deCharms does not disclose using an atlas with more than one magnetic property value prior probability from another subject to determine alignment of another magnetic resonance scan. deCharms does not disclose each and every element of independent claim 93, which is therefore patentable. Claims 94-95 depend from independent claim 93 and are therefore patentable as being drawn to an allowable base claim in addition to recitation of further patentable subject matter. Reconsideration and withdrawal of the rejection of claims 93-95 is requested.

Rejections in view of VanEssen

Claims 69-95 were rejected under 35 U.S.C. 102 (e) as being anticipated by U.S. Patent No. 6,591,004 to VanEssen et al. (hereafter VanEssen). Applicants respectfully traverse the rejection with the following arguments.

Van Essen is generally directed to a method for reconstructing surfaces and analyzing surface and volume representations of the shape of an object or structure corresponding to image data, in which the structure has been modeled as one or more physically distinct compartments. The characteristics of a compartmental model are specified in terms of the material types in distinct compartments and the nature of compartmental boundaries.

Applicants respectfully submit that VanEssen does not disclose an atlas having a plurality of nodes configured to store a magnetic property value as specified in independent claims 69, 77, 81, 92 and 93, and dependent claims 70-76, 82-87, and 94-95. VanEssen also fails to disclose an atlas having a plurality of nodes configured to store values of a statistical representation of at least one magnetic property value as specified by independent claims 78 and 88, and dependent claims 79-80 and 89-91.

The Office Action states that VanEssen's Abstract, column 20, lines 10-16, column 25, lines 20-55, and column 34, lines 5-22 disclose a method and apparatus for obtaining an MR scan of a subject, providing an atlas including a plurality of nodes corresponding to a plurality of voxels representing spatial locations of a subject, each of the nodes configured to store magnetic property values for each of the voxels, and a processor adapted to receive information from a scanner pertaining to the MR scan and to read the atlas. The Abstract of VanEssen does not describe in any detail the structure of the referenced atlas or its contents, in contrast to the Applicants' description of said atlas. Instead, the VanEssen Abstract discloses a method for reconstructing surfaces and analyzing surface and volume representations of the shape of an object or structure corresponding to image data in which the structure has been modeled as one or more physically distinct compartments. The Abstract makes no mention of nodes configured to store magnetic properties for each of the voxels, much less nodes including at least one or more magnetic property values as claimed by the Applicants. In column 20, lines 10-16, a three dimensional shape from an atlas is generally described as having been created by specifying a binary volume of a particular geometric shape or by importing a pre-existing segmented structure such as an atlas, but the atlas itself is not described. In column 25, lines 20-55, VanEssen references to "nodes" as vertices which are points on a surface and are not nodes in an atlas. In column 34, lines 5-22, VanEssen describes sub-cortical segmentation using a single

intensity threshold algorithm, and in line 16, a previously segmented atlas is referenced and is constructed from a single property. VanEssen does not disclose an atlas having a plurality of nodes configured to store a magnetic property value, thus, VanEssen does not disclose each and every element of claims 69-95.

Additionally, VanEssen does not disclose an atlas with a plrality of nodes configured to store tissue type prior probability values according to independent claims 77, 78, 88 and dependent claims 79-80, 83, 84, and 89-91.

The Examiner stated in pertinent part that VanEssen's Fig. 8, column 12, lines 13-22, and column 23, lines 21-25 teaches magnetic property values corresponding to a tissue type at one or more voxels. In point of fact, however, these citations do not disclose nodes including magnetic property values, much less nodes each including tissue type prior probability information, at least one magnetic property value, and location information. Fig. 8A is a material intensity histogram and Fig. 8B is a material intensity histogram. Column 12, lines 13-22 discloses material types as major structures in the brain, and material intensity histograms as peak intensity values for each structure. Column 23, lines 21-25 discloses that suitable input image data includes outputs of standard MRI scans and scalar representation of the combined outputs of multiple types of MRI scans, which are defined as intensities and or filtered values of the intensities. The applicants claims include at atlas with nodes, magnetic properties such as T1, T2, PD per tissue class per location or atlas node, which is entirely different than the citation in VanEssen.

The Office Action also states that VanEssen column 9, lines 43-67, column 10, lines 1-24 and 45-57, and column 44, lines 55-65 disclose tissue type prior probability corresponding to the tissue type. Column 9, lines 43-67, and column 10, lines 1-24, however, disclose that in a volume representation, image data is sampled at regular intervals along each spatial location, and

vector and scalar volumes. The key aspect of VanEssen disclosed in this cited section is generation of output representations in a sequence of steps that variously involve mathematical filters, image transformations, and algebraic volume combinations. The "priors" referred to by VanEssen are further described in column 28, lines 16-22. The prior probabilities claimed by the Applicants are based upon tissue occurrences at that node in atlas space, and are entirely different than what is described in VanEssen.

In column 44, lines 55-65, VanEssen refers to a maximum likelihood classification algorithm. This passage does not disclose or use tissue type probability in a particular node, or tissue type probability and at least at least one magnetic property in each node as does the Applicant's claimed method.

VanEssen does not disclose an atlas with a plurality of nodes configured to store tissue type prior probability values, thus independent claims 77, 78, 88 and dependent claims 79-80, 83, 84, and 89-91 patentable. Applicants respectfully request reconsideration and withdrawal of the rejection of claims 77-80, 83-84, and 88-91.

With respect to claims 78-91, the Office Action also states that VanEssen further teaches determining the mean and variance for the tissue type in column 13, lines 30-37, column 23, lines 28-39, column 28, lines 40 – 44, and column 29, lines 58 – 65. In column 13, lines 30 – 37, VanEssen discloses that the mean thickness across the brain as having a uniform thickness among species, which is completely irrelevant to the applicants invention. In column 23, lines 28-39, VanEssen describes a method of determining intensity peaks for a single subject across the entire brain in contrast to the applicants methods which compute the mean and variance for specific tissue types across subjects at locations in atlas space.

VanEssen describes noise in the images as a Gaussian distribution, which is neither a tissue type or magnetic property as described in the Applicants methods. In column 29, lines 58-

65, VanEssen provides a description of a Gaussian sign wave filter which is completely unrelated to the Applicants' claims.

VanEssen does not disclose each and every element of claims 69-95 which are therefore patentable. Reconsideration and withdrawal of the rejection is requested.

Summary

deCharms and *VanEssen et al.* both fail to disclose the notion of constructing an atlas to include nodes with tissue type probability information, magnetic property values, and location information. Since the prior art fails to disclose such an atlas, alignment of an MR scan and/or segmenting the MR scan of a subject by referring to such an atlas cannot occur.

In contrast, the Applicants' claimed invention utilizes information regarding the probability that a certain tissue type is at a location (node) in a given subject together with a determination of the type of tissue in that location -- by using at least one magnetic property value -- to more accurately align and/or segment an MR scan.

Additionally, deCharms and VanEssen et al. also fail to disclose, as claimed by the Applicants, the notion of constructing an *a priori* nodal atlas to include information about both location in three dimensional anatomic space as well as tissue type probability information based on the magnetic resonance properties of corresponding nodes and/or neighboring nodes, and transforming images obtained using the varying instructions of individual imaging instruments to match a reference nodal atlas by optimizing the probability match of both spatial location and magnetic resonance properties between the *a priori* determined nodal atlas and the subsequent voxel constrained magnetic resonance image. Since the prior art fails to disclose such a nodal reference atlas, alignment of the voxels of a subsequent MR scan and/or segmenting the voxels

of a subsequent MR scan of a subject by reference to such an *a priori* atlas, the applicant's claims are novel and non-obvious.

More importantly, neither VanEssen et al. nor deCharms disclose the Applicants' claimed combination of elements, including among other things, nodes which include tissue type probability information, at least one magnetic property value, and location information.

New claims 96-99 include the foregoing ideas or notions, and although the claims are not limited to just these ideas or notions, it is useful as a starting point to note they are not disclosed, taught or suggested by either *deCharms* nor *VanEssen et al.*

New claims 96-99 in view of deCharms and VanEssen

The Applicants' claim 96 recites a method for aligning and/or segmenting an MR scan. The method includes constructing an atlas from prior MR scans of subjects to include nodes. Each node includes tissue type probability information, at least one magnetic property value, and location information. The method also includes scanning a subject with an MR scanner to produce a magnetic resonance image, and interfacing the magnetic resonance image with the atlas and the tissue type probability information, magnetic property values, and location information thereof to determine, from the scan, the probability of tissue type by location in the magnetic resonance image. The claimed method further includes aligning and/or segmenting the MR scan.

In contrast to the Applicants' new claim 96, VanEssen does not disclose, among other things, magnetic property values for each node or voxel at all, much less using such magnetic property values for each node or voxel and tissue type probability information together as a method of aligning and/or segmenting an MR scan.

The Applicants' claim 97 recites a method of aligning and/or segmenting MR scan. The method includes constructing an atlas from at least three MR scans of other subjects which define node locations in anatomic atlas space, which are independent of MR imaging platform voxel properties whereas voxels are dependent upon MR imaging instrument instructions and nodes are independent of MR imaging platform instructions, each node characterized by probability information for at least four independent properties. The at least four independent properties include location in three dimensional atomic atlas space, prior probability of specific tissue types at this nodal location, statistics of at least one magnetic resonance property assigned to specific tissue types at this nodal location, and prior probability of specific tissue types of neighboring nodes for each tissue type at this nodal location. Magnetic resonance property values may include one or more of such parameters as T_1 or T_2 for the identical nodal location in anatomic space. The method further includes scanning a subject with an MR scanner to produce a magnetic resonance image representative of that subject comprised of voxel volume elements constructed in accordance with the MR imaging instrument instructions, interfacing the magnetic resonance image with the *a priori* nodal information from the previously constructed atlas, and aligning the MR scan and/or segmenting the MR scan to maximize the post probability of its voxel components matching both position in anatomic space and at least one MR tissue characteristic of the nodes determined *a priori* in the reference atlas.

Claim 97 is not anticipated by either deCharms or VanEssen for at least the same reasons as discussed above in connection with claim 96 because claim 97 includes the distinguishing features of claim 96 as discussed, together with additional features resulting in a novel and non-obvious combination of elements. Accordingly, for at least the same reasons as discussed above with respect to claim 96, claims 97 and 98, which depends from claim 97, are in condition for allowance.

Claim 99 recites a method of creating an *a priori* nodal atlas as a reference for the consistent alignment and/or segmentation of subsequent MR scans constructed from: three or more MRI scans which are used to create a nodal atlas, each node containing information about location in three dimensional anatomic space, as well as information about magnetic resonance properties of each location in anatomic space for specific tissue types and prior probability for specific tissue types and prior probability of specific tissue types of neighboring nodes for each tissue type at this nodal location. The method further includes achieving uniform MR scan alignment and/or scan segmentation of subsequent scans by operating on the voxel based images created in accordance with instructions of each imaging instrument and applying transformations which maximize the probability of matching each voxel to a corresponding node in a reference atlas.

Claim 99 is not anticipated by either deCharms or VanEssen for at least the same reasons as discussed above in connection with claim 96 because claim 99 also includes the distinguishing features of claim 96 as discussed, together with additional features resulting in a novel and non-obvious combination of elements. Accordingly, for at least the same reasons as discussed above with respect to claim 96, claim 99 is in condition for allowance.

In summary, VanEssen et al. does not disclose each and every element of the Applicants' new claims, and does not anticipate the Applicants' claimed invention for at least the foregoing reasons.

CONCLUSION

In view of the amendments and the remarks set forth above, Applicants contend that neither deCharms nor VanEssen disclose each and every element of claims 46-48, 50-52,

54-58, and 69-95. Applicants respectfully request the examiner to reconsider and to withdraw the current rejection and pass the claims into allowance.

Dated:

Respectfully submitted,

By_____

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